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Designing a Comprehensive Information System for Safeguarding the Cultural Heritage: Need for Adopting Architectural Models and Quality Standards

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Abstract

In every sphere of activity, knowledge or information is the principal constituent determining the quality and relevance of actions. Social, cultural, technological, and economic progress is based on what we have achieved till now. Each heritage item contains knowledge embedded in them. The cultural heritage of any place is an integral part of the life of the people who belong to it irrespective of the community, caste, religion, the social and economic status they possess. So conservation of heritage, especially knowledge heritage, is essential for future generations for sustainable development. Even though regional level conservation efforts are occurring in India, no comprehensive information system that gives the complete perspective of the item or environment to be conserved has been developed for the heritage properties. Creating, managing, and accessing such resources irrespective of the geographical location enhance visibility and broader access. It can also support the day-to-day activities of conservationists and archeologists at the location. The study intends to discuss the need for developing and managing such a comprehensive information system that can preserve, conserve and retrieve the knowledge heritages in a single platform. Further, it identifies the requirements of adopting widely accepted guidelines, policies, methods, and standard practices for preserving and retrieving cultural heritage information to circumvent any economic, legal, and technological concerns. The necessity of adopting suitable architectural models and quality standards to design information systems to safeguard cultural heritage has also been emphasized. Further, the researcher perceived the need to have an effective digital archiving of manuscripts and other heritage items for conservation and information retrieval not listed in the UNESCO World heritage list to enhance its visibility and safeguard it for generations to come.

Keywords: Culture, heritage, Cultural heritage, heritage information system, information portal, CHIS, information system, metadata, semantic web technology, ontology, India

1. Introduction

Culture is a way of life inherited and followed by human beings as a member of the social group. It is dynamic, diverse, and closely linked with human life. Culture is something we do, a performance that fades into memory and then disappears, but the records of culture consist of artifacts that we make, which persist but inevitably decay (Lyman and Kahle, 1998). It has different aspects such as philosophy, religion, art, traditions, festivals, architecture, music,

sculpture, space, customs, and other issues about life. Being the expression of human nature, culture differs from country to country. Development of the culture is a historical process that passes from one generation to the next and is marked as to how one person is leading his life. Culture is an intangible and wide-ranging concept whose theoretical basis are several traditional fields of research, including anthropology, management, psychology, and other social sciences (Oxford Dictionaries, 2010). However, a society's wealth cannot be treated as its culture, but wealth is an integral part of its culture.

Something which is inherited from the past is simply called heritage. The transmission of culture is carried forward from one generation to another and is influenced by the physical and social environment. Heritage items are a legacy inherited from the past and are a sign of the societies' achievements and tags to who, how far past generations have reached, and where they have left us on the path to progress. Heritage is anything valued by people today that was also valued by previous generations (Welch, 2014). Heritage is an instrument for growth and change. Heritage contains knowledge embedded in them on the technology we have developed, the discoveries we have made in different subject areas like medicine, engineering, astronomy, physics, and the like. It gives a good perspective of our culture and civilization.

The culture we inherit from our predecessors is called our cultural heritage. This heritage exists at various levels, viz. -human heritage, national heritage, and cultural heritages and has historical and cultural values. Heritage can be of many things-buildings, monuments, architectural creation, treasures of knowledge, land, language, ecosystems, scientific inventions and discoveries, intellectual achievements, etc. Cultural Heritage is the legacy of physical science artifacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present, and bestowed for the benefit of future generations (UNESCO, n.a). Cultural heritage is a comprehensive and broad concept and is an essential part of any culture. Cultural Heritage is an expression of the ways of living developed by a community and passed on from generation to generation, including customs, practices, places, objects, artistic expressions, and values, and often expressed as either Intangible or Tangible Cultural Heritage (ICOMOS, 1999). The information about cultural heritage artifacts is generally heterogeneous and represented using complex data management frameworks. It is the commonwealth of human being transferred from generation to generation to understand the cultural and social developments. It helps to understand the history of ages. Most of the cultural heritage items are evidence of past events and is more than a domain in the actual scenario. Such cultural heritage materials are evidence of human activities of cultural and social relevance and are to be kept for future generations. It comprises a

broad spectrum of functions about the study and preservation of physical evidence of the history of all sorts of human activities (Doerr, 2003). Cultural heritages are treated as fundamental sources of education, research, and learning. Cultural heritage, a legacy which is shared from the past need to be preserved, curated and disseminated over the Internet. Further, research, developments, and technological advancements in all fields depend on the heritage we conserve. Otherwise, in many areas of progress, we will be forced to start again from scratch.

An information system for cultural heritages consists of objects and artifacts that are to be converted from analog content to digital format for its effective utilization. Developing such a system provides better, more comprehensive, and easier access to digitized content that is beneficial for the present as well as future generations. Such historical contents are digitized by adhering to universally accepted guidelines, methods, and practices for its long-term sustainability. Digitization and preservation of cultural heritage information can showcase the treasures of the nation at a global level. There are many challenges associated with the development of such an information system and providing access to them. However, the process of digitization and preservation, which are recognized to be of high importance, requires close collaborations and support among the Member State, cultural institutions, and public-private partnerships.

Designing and developing a comprehensive Cultural Heritage Information System (CHIS) is very significant that can keep our memory resources safe for the future. Further, the quality and effectiveness lie in various factors such as the quality of the contents, usage and user satisfaction, performance of the system, task analysis, etc., including socio-economic and environmental factors.

1.2 Heritage of India

The Indian culture is one of the most ancient and influential cultures of the World. India is incredibly rich in its culture and, most of the time, equated to its civilization. It is probably one of the most ancient and most extensive cultural heritages in the World. India has a rich cultural heritage of numerous sites, monuments, artifacts, and intangible cultural heritage elements. Few of them are being listed on UNESCO's World Heritage List. According to Indologists, Indian culture stands not only for a traditional social code but also for a spiritual foundation of life. Cultural heritage can be a tangible one and be more visible or intangible where it is difficult to explain or interpret because of its complexity. Any cultural heritage item which cannot be touched or seen comes under the category of intangible heritage. In its World list from India, thirty-six

cultural heritage sites have been identified and included by UNESCO as part of its heritage conservation. Figure 1 represents the list of heritage properties listed in the UNESCO world list under cultural, natural, and mixed heritage from Asia and Pacific region. Among them, heritage properties listed from India have also been shown. The data extracted from UNESCO World Heritage List Statistics updated till 08th February 2021 available at <http://whc.unesco.org/en/list/stat/>

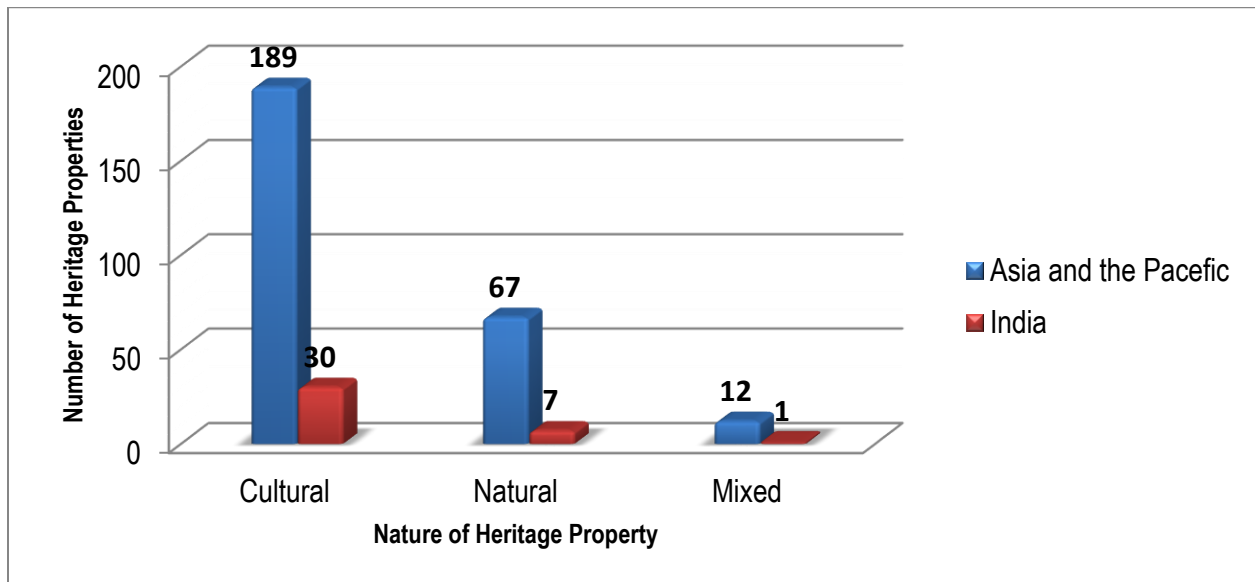


Figure 1. Heritage properties listed in the UNESCO World List

It is found from available data (as on 08th February 2021), 23.91% of the total heritage properties identified by the UNESCO list belong to the Asia Pacific region and 7.05% belong to India. India consists of 30 cultural sites, 7 natural sites, and 1 mixed site. They are unique with high artistic value and are to be promoted adequately. Table 1 depicts the complete list of world heritage sites in India with the details such as nature of heritage property, states it belongs to, and the year in which it has been added to the list. Many other countries possess a high artistic and cultural value that has not been adequately recognized and promoted as they are not listed in the UNESCO's list. With a mandate to preserve and conserves cultural heritage globally, the Ministry of Culture (MoC) promotes tangible and intangible art and culture. The National Mission for Manuscripts, National Mission on Libraries, National Mission for Monument and Antiquities, and Gandhi Heritage Sites Mission are the four important missions under MoC to preserve and promote the country's cultural heritage. Museum movement in the country is supported by the Archaeological Survey of India, which comes under the purview of MoC. The MoC is also responsible for maintaining all archival records of the country through the National Archives of India.

Table 1: List of World Heritage Sites in India

Sl. No.	Year of Inscription	Name of the Cultural Heritage Site	Nature of Heritage	States it belongs to
1	1983	Agra Fort	Cultural	Uttar Pradesh
2		Ajanta Caves	Cultural	Maharashtra
3		Ellora Caves	Cultural	Maharashtra
4		Taj Mahal	Cultural	Uttar Pradesh
5	1984	Sun Temple, Konarak	Cultural	Orissa
6		Group of Monuments at Mahabalipuram	Cultural	Tamil Nadu
7	1985	Kaziranga National Park	Natural	Assam
8		Keoladeo National Park	Natural	Rajasthan
9		Manas Wildlife Sanctuary	Natural	Assam
10	1986	Churches and Convents of Goa	Cultural	Goa
11		Khajuraho Group of Monuments	Cultural	Madhya Pradesh
12		Group of Monuments at Hampi	Cultural	Karnataka
13		Fatehpur Sikri	Cultural	Uttar Pradesh
14	1987	Elephanta Caves	Cultural	Maharashtra
15		Great Living Chola Temples	Cultural	Tamil Nadu
16		Group of Monuments at Pattadakal	Cultural	Karnataka
17		Sundarbans National Park	Natural	West Bengal
18	1988	Nanda Devi and Valley of Flowers National Parks	Natural	Uttarakhand
19	1989	Buddhist Monuments at Sanchi	Cultural	Madhya Pradesh
20	1993	Humayun's Tomb, Delhi	Cultural	Delhi
21		Qutb Minar and its Monuments, Delhi	Cultural	Delhi
22	1999	Mountain Railways of India	Cultural	Darjeeling, Nilgiri and Kalka-Shimla
23	2002	Mahabodhi Temple Complex at Bodh Gaya	Cultural	Bihar
24	2003	Rock Shelters of Bhimbetka	Cultural	Madhya Pradesh
25	2004	Champaner-Pavagadh Archaeological Park	Cultural	Gujarat
26		Chhatrapati Shivaji Terminus (formerly Victoria Terminus)	Cultural	Maharashtra
27	2007	Red Fort Complex	Cultural	Delhi
28	2010	The Jantar Mantar, Jaipur	Cultural	Rajasthan
29	2012	Western Ghats	Natural	Tamil Nadu, Kerala, Karnataka,

				Goa, Maharashtra and Gujarat
30	2013	Hill Forts of Rajasthan	Cultural	Rajasthan
31	2014	Rani-ki-Vav (the Queen's Stepwell) at Patan, Gujarat	Cultural	Gujarat
32		Great Himalayan National Park Conservation Area	Natural	Himachal Pradesh
33	2016	Archaeological Site of Nalanda Mahavihara at Nalanda, Bihar	Cultural	Bihar
34		Khangchendzonga National Park	Mixed	Sikkim
35		The Architectural Work of Le Corbusier, an Outstanding Contribution to the Modern Movement	Cultural	Chandigarh
36	2017	Historic City of Ahmadabad	Cultural	Ahmedabad
37	2018	Victorian Gothic and Art Deco Ensembles of Mumbai	Cultural	Maharashtra
38	2019	Jaipur City, Rajasthan	Cultural	Rajasthan

The Government of India has initiated many schemes and projects to conserve the country's heritage for the cultural heritages that are not part of the World Heritage Sites List. HRIDAY (Heritage City Development and Augmentation Yojana) Scheme by Ministry of Urban Development, 'Adopt a Heritage' by the Ministry of Tourism, PRASAD (Pilgrimage Rejuvenation and Spirituality Augmentation Drive), etc. are few among them. There are a number of initiatives by the institutions under the Government of India like IGNCA (Indira Gandhi National Centre for the Arts), Sahitya Academy, National Mission on Intangible Cultural Heritage, National Mission on Education, National Digital Preservation Programs involved in the preservation of cultural heritage resources in India

2. Review of Similar Works

Application of ICT and digital repository software can support the documentation conservation of cultural heritage items by showcasing them on the public platform to make the past available to the present and the future. There are various digital archival and digital repository tools and techniques both in commercial and open-source platforms available to effectively perform conservation practices such as recording, documenting, protecting, and managing the cultural heritage items. However, in India, there is no such comprehensive retrieval system developed with

this objective to provide comprehensive coverage for the cultural heritages identified by UNESCO. Further few studies have only been conducted at the base level to create technological infrastructures to support activities related to the specific context of Cultural Heritage. A review of the literature indicates that there are efforts at a smaller scale in India at individual and organizational levels to conserve the cultural heritage of a particular structure. The process and methods of data acquisition, tools for cultural heritage management, and the techniques, devices, and applications are advancing in the cultural heritage domain. Few studies at regional levels have also been identified, but they have not helped to initiate any in-depth studies or development in continuation. A study conducted by Srivastava on remapping Banaras discussed the importance of applying technologies to conserve cultural heritage resources (Srivastava, 2002). Sankar discusses the need for conservation of heritages of Banaras through technology and emphasizes the need for heritage legislation (Sankar, 2003). Kumar and Shah (2004) discussed the digitization project of UNESCO named 'The Memory of the World' initiated in the year 1993. 'Down Memory Lane' the manuscript digitization pilot project initiated at the National Library of India, also highlighted in the study. Ramana (2005) highlighted the benefits of digital preservation, focusing on the manuscript collections of the National Library of India and discussed some of the indigenous methods and techniques that can help preserve the palm leaf manuscripts contain cultural resources. Majumdar (2005) examined the historical aspects of literary heritage and the cultural heritages available in different formats such as manuscripts, palm leaves, cotton, silk, wood, bamboo, and copper plates and also explained the history of artistic heritage, literary heritage, and recorded knowledge of India and the National Mission on Manuscripts (NMM) initiatives taken by Government of India. Maltesh et al. (2007) recognized the organizational role of metadata for information retrieval and access to cultural resources. Further, it also discussed the digitization process associated with the conservation and preservation of cultural heritage resources given such projects as 'Memory of the World' (UNESCO), Czech National Library, National Library of Australia, etc.

Poluru has attempted to build an image repository for Indian cultural heritage materials by using Dublin Core Metadata elements and DSpace digital library software. The study suggested that there is ample scope for further research in developing a National Repository for Indian Cultural and Heritage materials with OAI-PMH (Open Archives Initiatives-Protocol for Metadata Harvesting) for interoperability (Poluru, 2009). However, the researcher could not trace out any such information system created based on providing access to cultural heritage items listed in

UNESCO World list using internationally accepted standards and software technologies for the benefit of the interested. Singh (2012) discussed the importance of cultural heritage resources integrated with the history, traditions, and culture of a country and making them accessible to the global community through the digital preservation process. The study further focused on the value and importance of preserving the cultural heritage of India. Another study conducted by Raman Nair emphasized applying different information and communications tools to conserve the cultural heritage of Banaras (Raman Nair, 2013). The author highlighted the various mechanisms and risks associated with them in protecting, creating, and disseminating cultural heritage information and suggesting that digital preservation and conservation of heritage should be tackled based on robust data and information infrastructure. Another study by the same author discusses the application of ICT on digital archiving of manuscripts and other heritage items for conservation and information retrieval (Raman Nair, 2008).

Similarly, many such projects and initiatives at the international level preserve and document cultural heritage items. Angkor Wat project of UNESCO, “EUROPEANA”, from Europe and Red de Ciencia y Tecnología para la Conservación de Patrimonio Cultural (Network of Science and Technology for the Conservation of Cultural Heritage) of Spain etc. Lithuania was one of the first European Union countries with a national strategy of cultural heritage digitization (European Commission, 2008). Few studies at the individual and organizational levels have been initiated in India also. However, many of such studies are not in-depth studies or have infused any development in continuation. Scopigno et al. discussed the applications of solid printing techniques and technological utilization of 3D printing in the cultural heritage domain (Scopigno, et al, 2014). Authors suggest solutions to cope with the specific issues in the cultural heritage domain that characterize the usage of digital fabrication. Jan emphasized the importance of having a collaborative working model between the researcher and the community (Jan, 2018). Such efforts can promote public awareness of the importance of heritage conservation and achieve the research goal more effectively and efficiently.

3. Need of Information System for Cultural Heritages

Information and knowledge available in the form of digital or digitized format last longer than the conventional print format and can transfer regardless of space and time. Many cultural heritage sites had been destroyed or damaged accidentally, deliberately, or by natural disaster in the past and preserved cultural heritage for future generations; effective measures are needed to document them (Jan, 2018). Loss of knowledge content by theft, mishandling, or natural calamities can

avoid by keeping them at different places with the help of digital storage technologies. Documentation and information systems play a pivotal role in the management, maintenance, and guidance of any heritage conservation project. The management and processing of information are central issues in the cultural heritage (CH) field (Soler et al., 2013).

Developing, managing, and accessing cultural resources through a comprehensive information system under a national level authority, irrespective of the geographical location, can enhance visibility, enable more comprehensive access and ensure safety and conservation. They can be used for personal enjoyment and enable visualization and scientific study without the need to have the physical experience of the object or place (Jan, 2018). Maintaining a continuously updated database on cultural heritage items would be of high significance from the conservation perspective. Further, access to such an exclusive digital archive would greatly support administrators, tourist departments, culture departments, development administration, and conservation activists to monitor the existing condition of the heritage items and site. The information system created under the cultural heritage of India must have relevance to different subject fields like History, Archeology, Manuscriptology, Art, Administration, Knowledge Management, Computer Science, Library Science, Information Science, etc. Further, creating such an exclusive system can promote awareness of national heritage and stimulate cultural developments.

The cultural heritage information system created can be engaged in visualizing the country's cultural heritage and act as an interactive multimedia documentation system. Hence conserving the items of heritages is a common requirement of the people belonging to the region for future generations. It is one of the essential responsibilities of the present. The archive developed has to cover the cultural heritage depicted in the form of published documents in different languages, images, audios and videos and visuals on performing arts, buildings, sculptures, ecosystem, monuments, utensils, etc., and the history and knowledge about them and any other property belonging to the heritage.

4. CHIS and its Life Cycle

According to Meyer et al. (2007), an Information System stands for a combination of diverse data types (recorded in databases) accessible through an interface proposed by the system. Heritage information systems provide information about material objects to offer faceted access by type of object, person, place, date. Facilities like advanced searching options, document indexing, practical and interactive retrieval mechanisms and interoperability, availability of different file

extensions, etc., also opened up new opportunities and facilities to provide better access. At the same time, they also pose several challenges too. Contents in a cultural heritage system can be verbal expressions, musical expressions, tangible expressions, or even expressions by action or a combination of them. A typical CHIS involves identifying, acquiring, and managing digital objects of cultural items, its conservation, and its presentation through portals or publication and teaching. Processes involved in a typical CHIS are represented in figure 2.



Figure 2. Life Cycle of CHIS

The capacity of an information system to manage and present information in a proper and better way shows its efficiency and quality. Digital tools and information systems might help with the storage and retrieval of relevant information, the processing of this information for more adequate and coherent management of cultural heritage, and the presentation of this information in public exhibitions, vulgarization leaflets, and scientific documents (Santana-Quintero and Addison, 2007).

5. Standardization and Frameworks for CHIS

Cultural heritage is of extremely high importance to guarantee the present and the future of resilient communities. Building an information system for cultural heritage artifacts is an effective mechanism to preserve and store endangered and degraded heritage items. It can keep our memory and also resources unscathed for the future. There is a need to develop a reliable information system to support researchers, administrators, and concerned departments and

organizations involved in conserving the heritage items. Such a system can also serve as a unique source for researchers in different disciplines. The use of various digital or archival repository software can hinder the accessibility and the integration of the variety of information between stakeholders. It can also lower the visibility of such resources. The way data are stored and handled is crucial in preserving and conserving cultural heritage information. Hence there is a need for standardization from the data collection to the retrieval mechanisms.

Standards offer a base model for creating practical systems and guidelines, give the rules for structuring information so that the data into a system can be reliably read, sorted, indexed, retrieved, and communicated between other systems (Gabrielli and Malinverni, 2007). Best practices are to be adopted to collect items of cultural importance. The ideal technical tools are to preserve, document, manage, present/visualize and disseminate them. Making the digital collection accessible to the interested enhances the visibility of the knowledge content of the region to conservation experts, administrators, and others concerned and researchers at the global level. Hence, there is an urgent need to document and manage such endangered heritage items. Information and communication technologies have influenced every stage of the CHIS life cycle, from its design to use.

Creating CHIS facilitates storing, conserve, searching, and retrieving resources such as documents, structures, and the digital replica of the environment with multimedia in a customized searchable interface. Unlike cultural heritage sites, such an organized system facilitates data sharing, which can be used to restore. Such a system also supports expanding awareness and understanding of the current situation of cultural heritage and the need for its protection. The access system of ideal CHIS is represented in figure 3.

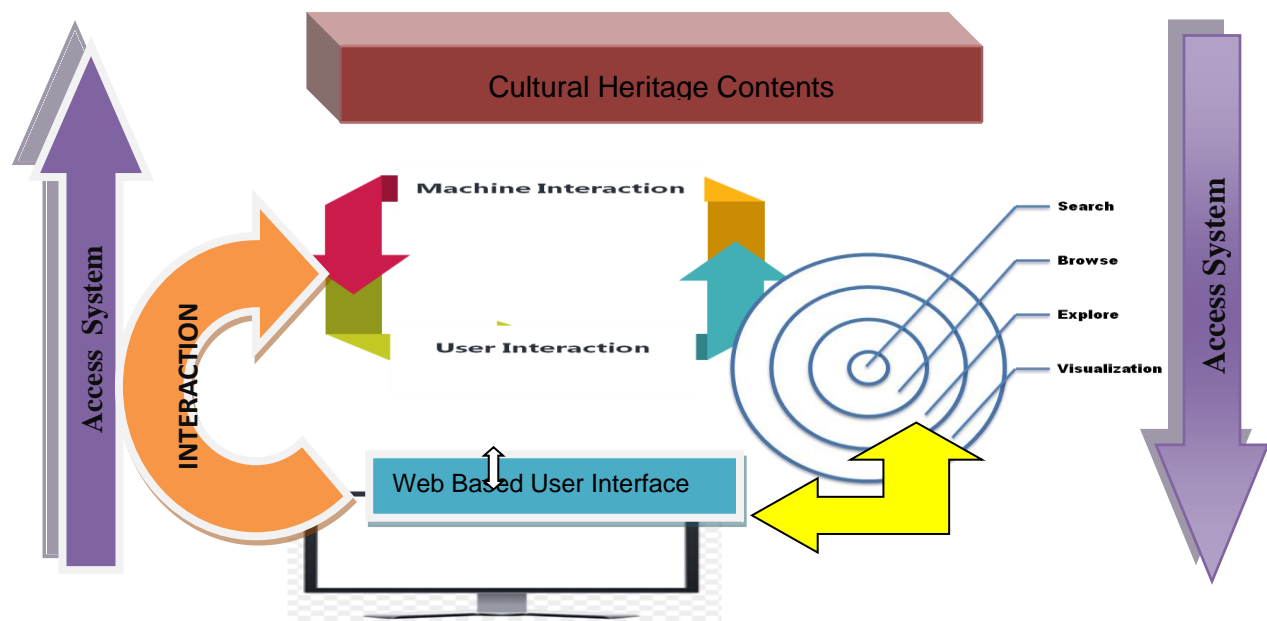


Figure 3. Simplified Interface of an Ideal CHIS (Source: Author)

5.1 Digital Preservation and Access

The processes involved in the digital preservation of cultural heritages are to be dealt with and implemented with high importance and care. The Blue Ribbon Task Force Report (2008) summarized five major obstacles in building sustainable digital preservation programs such as 1) inadequacy of funding models to address long-term access and preservation needs; 2) confusion and/or lack of alignment between stakeholders, roles, and responsibilities with respect to digital access and preservation; 3) inadequate institutional, enterprise, and/or community incentives to support the collaboration needed to reinforce sustainable economic models; 4) complacency that current practices are good enough, and 5) fear that digital access and preservation is too big to take on. Unlike past decades, advanced digital technologies can effectively and efficiently be used to collect and process cultural inheritances. The emerging state of the art digital and networking technologies such as 3D and 2D digital imaging, laser scanning, thermal capturing cameras, multispectral imaging, reverse engineering, photogrammetry, GIS (Geographical Information System), GPS (Global Positioning System), web technologies, web mapping, and digital repository software bring new possibilities in preserving the heterogeneous cultural heritage items. Long-term preservation of cultural heritage resources needs to be ensured.

5.2 Metadata Framework

Metadata is represented as information about information to indicate the properties of a specific item and is an essential component of any information system. It enables context to data content and to understand the relation between the object through ontology. Once the heritage items are identified, the quality and the quantity of collected data and metadata are to be evaluated. The potential, effectiveness, and appeal of any such information system are solely determined by them. Universally accepted and suitable metadata standards need to be selected for the optimum search, discovery, and better retrieval of items deposited in the information system. Despite sophisticated content-based image retrieval systems, metadata remains a powerful source for retrieval based on images' known context and context (Poluru, 2009). Name of the creator or producer or author, subject, format, and all other bibliographic details (metadata) need to be incorporated by using a standard metadata scheme. A clear perception of the features of different metadata standards and systems and their suitability for effectively describing and efficiently retrieving heritage objects is essential. Metadata is helpful for many ways-discovery and searching a particular item, interoperability, technical management, etc. GIS plays a significant role in managing the cultural heritage information with a focus on multidisciplinary and interdisciplinary dimensions and is supportive in rendering metadata details, analysis, research and decision making processes, evaluating and predicting sustainability and also it stores and retrieves a large amount of data and its effective dissemination. The metadata standard chosen should be flexible and give freedom to attach any metadata about the cultural heritage items. The metadata system used in the information system should empower to describe the heritage objects consistently. Dublin Core-based descriptive metadata need to be adopted that should promote interoperability with other widely accepted standards

5.3 Ontology Frameworks for CHIS

Ontology follows relatedness between the terms and sorts individual items into a specific scheme. Many ontology frameworks exist, and a few among them are CIDOC CRM, AAT, BIBO, FRBR, CiTO, FaBio, HiCO etc. The CIDOC (International Committee for Documentation of the International Council of Museums) Conceptual Reference Model (CRM) provides definitions and a formal structure for describing the implicit and explicit concepts and relationships used in cultural heritage documentation (Doerr, 2013). CIDOC-CRM (Conceptual Reference Model) is an internationally adopted ontology framework dedicated to cultural heritage. It is considered one of the most widely used ontologies for representing and classifying cultural heritage data. It is

concerned with the annotation of 3D models and is compliant with ISO 21127:2006. CIDOC CRM is highly heterogeneous and can effectively describe reconstructed objects, materials, spatial and symbolic elements hence used to develop CHIS in the Indian context to ensure data integrity and consistency. Processes involved in the data source layer represented in an information system of cultural inheritances are depicted in figure 4.

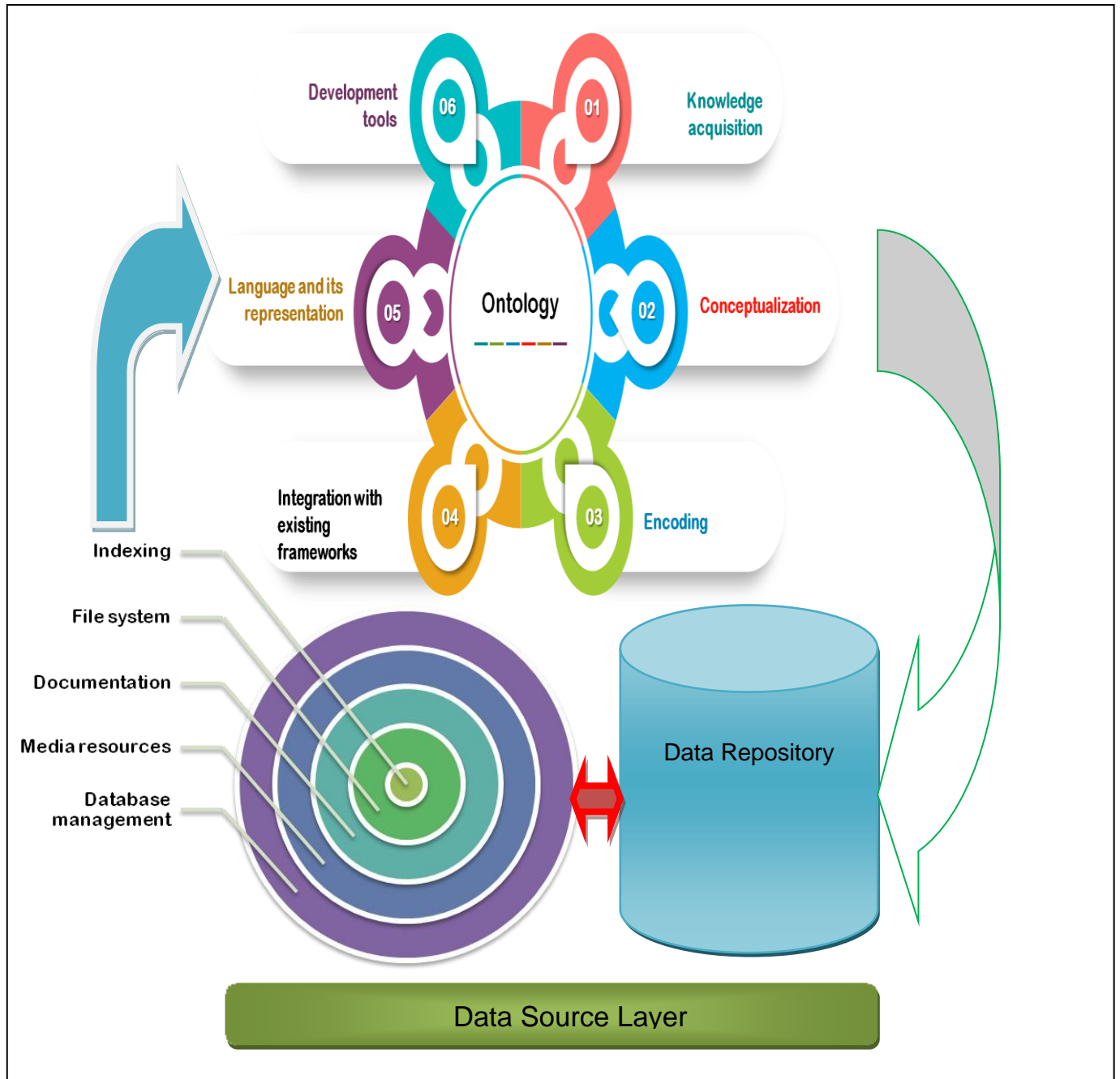


Figure 4. Data source layer represented in a CHIS (Source: Author)

The validity of the information system developed for cultural heritage is to be ensured using controlled vocabularies or ontologies. The consistency of inventory data is essential in the multi-

lingual environment to enhance the precision across the cultural contents. Authority files are to be made using adequately controlled vocabularies to describe and classify the cultural heritage items while creating the information system. A hierarchical controlled vocabulary is suitable to provide vital information to be integrated with the information system that can offer a comprehensive navigational tool for browsing through digital content. The use of both controlled vocabulary and natural language and a hybrid system of both controlled terms and free keywords will ease the difficulty of describing the cultural heritage items.

5.4 Technological Support for CHIS

Recent advancements in various digital and information technologies offer adequate technical support to create efficient and user-friendly heritage systems. Different Information and communication technologies and digital tools can also be used to document, manage, preserve, and communicate data and archive on cultural heritage. There are many advanced-level digital technology tools and techniques currently under development that can also accelerate the digitization process. There are various digital archiving packages available under commercial as well as open-source platforms. Eprints, DSpace, Arches, Greenstone, etc., are some of the digital repository tools under the open-source category to develop heritage information systems. These packages can act as an ideal solution for creating a cross-platform application in the field of heritage resources to archive, manage and distribute. The tools and techniques used to design and develop the information system for cultural heritage must be adequately analyzed before selecting the most appropriate one.

5.5 Sustainability of CHIS

The sustainability of any CHIS depends on technical and technological, infrastructural, level of digital literacy of the stakeholders, copyright, and other legal issues related to the cultural resources and its digital management. In a broader sense, these sustainability factors can be categorized under three interdependent and interrelated dimensions such as economic, social, and environmental factors. Further, the quality and sustainability of any information system also depend on different other factors associated with the quality of the contents, performance of the system, task analysis, usage, and user satisfaction. Holistically, visualizing the cultural heritages can enhance its visibility and can ensure its long-term sustainability. The information systems designed for cultural heritage are to secure international collaborations and facilitate data sharing to provide seamless access to heterogeneous collections. India is rich in its culture, languages, and

scripts. Around 18 languages having their scripts have been identified as the official languages among the total languages of more than 400. Different cultural heritages are inscribed in various languages, and scripts are needed to be translated to the known languages. Legal provisions need to be formulated to protect Indian heritage and the documentation related to it. There are many factors, including social and political issues preventing the promotion of nation's cultural diversity and multiculturalism. Participation of the Government and the community are significant in protecting the sites of cultural heritage importance with prudent management is essential for its sustainability.

6. Conclusion

A heritage information system can store, preserve and retrieve a large number of items. The items available in a cultural heritage information system are heterogeneous. A CHIS's quality and effectiveness lie in various factors such as the quality of the contents, usage and user satisfaction, performance of the system, task analysis, etc., including socio-economic and environmental factors. Necessary steps to be initiated to create a national-level information system for managing and preserving cultural heritage inheritances. Such a comprehensive system eliminates duplication efforts in developing a reliable system and can also point out the issues that need further improvements. Creating a system under a single authority can also enable uniformity in every aspect of cultural data and information systems. Suitable archiving tools and cataloging standards to be adopted to create, maintain uniformity, and retrieve them efficiently. Open Source platform can have a more significant impact on this. Designing such as comprehensive system supports the researchers, administrators and concerned departments, and organizations involved in the conservation of the heritage – an item, a monument, or a region. Further, many of the sites and things that are not listed in the cultural heritage list of UNESCO World list have to be identified, protected and preserved. Access, conservation, preservation, and education on such unlisted cultural heritage are also essential. Such frameworks and standards chosen are to be compliant with every kind of heritage item and site. It should also allow the management of very diverse types of data. The information system developed should further allow recording, using, and representing any cultural heritage items/sites, enabling the users to perform different kinds of contextual searches to retrieve textual and graphically represented data and resources. Data integration of cultural heritage needs to be ensured using a suitable ontological approach and its correlation with related information systems. Hence creating a cultural heritage portal can improve the preservation and conservation of the heritage richness of the country.

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